

Applying Modern Technologies to Ensure Festival Tourism Safety

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Introduction: Music festivals such as Sziget, OZORA and EFOTT attract thousands of visitors on occasion, making the safety of festivals and their surroundings a top priority. Ensuring the safety of mass events is an increasingly complex task these days, which cannot be achieved by relying solely on traditional law enforcement measures.

Objective: The aim of my thesis is to present technological solutions that can be used to effectively increase the safety of large-scale events such as the OZORA Festival. In my study, I provide an overview of the technological possibilities and present the special applications of drones, RFID/NFC systems, biometric identification and digital radio communication devices, explaining the position of the festival organiser and festival visitors in relation to each application.

Methodology: My research is based on a combination of direct observation and qualitative methods. The literature review provides the theoretical framework, my personal experiences at festivals, recorded interviews and questionnaires provide the practical perspective, while legal documents present the formal regulatory environment. Through this complex methodological approach, my study provides an opportunity to present the application and possibilities of modern technologies that help to ensure and guarantee the safety of festival tourism. The study pays particular attention to drones, RFID/NFC systems, biometric identification and digital radio communication devices. The research is based on a review of the literature, case studies and personal interviews, including interviews with Árpád Zimányi, the main organiser of the OZORA festival, and Adrienn Riba, an “experienced” festival-goer.

Results: In addition to traditional security measures, the use of modern technologies, including camera systems, license plate and facial recognition combined with artificial intelligence, drones, and electronic access control systems, are increasingly playing a role in securing events, managing crowds,

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and preventing emergencies. New technologies also play a key role in rapid response to emergencies, crisis management, and prevention. Festival security systems are increasingly integrated: cameras, websites, apps, drones, real-time data sharing between organisers and insurance providers, as well as event attendees, can take security to a higher level. Future developments should focus on transparency, ethical application, and respect for participants' rights, as festival attendees prioritise privacy over security. Online resources, practical experiences, and international examples also provide a good indication of the direction of development.

Conclusion: Modern technologies contribute significantly to maintaining and increasing the security of large music festivals, however, when using these technologies, special attention should be paid to ethical and data protection issues. The results of the study contribute to the international literature on festival security and offer guidance to festival organisers and private security professionals. I suggest directions for future research on the topic, development and use, along with the implementation of data protection regulations.

Keywords: tourism, tourism security, festival tourism, festival tourism security, application of modern technologies

Introduction

Thanks to the favourable economic and social effects of recent decades, tourism has become a global way of life (HALL et al. 2004b). It has grown to such an extent in terms of social and economic potential in recent decades that ensuring safe travel and accommodation is no longer just in the interests of service providers and local authorities, but also of the states concerned (BUJDOSÓ 2010).

One of the key prerequisites for the emergence and successful development of the tourism industry is safety (PIZAM–MANSFELD 1996; HALL et al. 2004a; MÁTYÁS 2014). If a tourist destination is unable to eliminate the dangers lurking for visitors, avert threats to tourists and convey a sense of security, then it cannot be considered competitive, even if it offers attractive local conditions (PUCZKÓ–RÁTZ 1998). Nowadays, safety determines the functioning of an existing or potential tourist destination to such an extent that safety factors can also be interpreted as basic conditions for the tourism industry (MICHALKÓ 2012).

Institutionalised threats, public health conditions and living conditions are security factors which, individually or collectively, can become permanent or temporary obstacles to the development of the tourism industry and the growth of traffic (MICHALKÓ 2012).

Festivals, as institutionalised products of the tourism industry, can be excellently linked to tourism and have a positive impact on the economic and social structure of a given settlement or region. The most significant aspect of festivals is their economic role. Festivals enhance the attractiveness of tourist destinations and offer additional programmes for tourists visiting for other purposes (SULYOK–SZIVA 2009). One of the main segments of festivals is music festivals, which are a type of festival based on a specific

theme, focusing on musicians and bands who entertain participants with their music in a unique environment over several days or weeks (DING–HUNG 2021). In Hungary, there are local, national and international festivals, which are among our most successful tourist products (Magyar Turisztikai Ügynökség [MTÜ] 2021).

In the 21st century, more and more music festivals are being held in Hungary, covering a wide range of genres (MTÜ 2021). Domestically organised festivals are therefore not only important in terms of musical life, but also have a significant impact on Hungary's tourism and economy. The popularity of these events is also reflected in the fact that in 2019, most of the major domestic festivals (such as Balaton Sound) achieved record attendance figures (MTÜ 2021). The data presented above clearly shows that security is a top priority at music festivals, and modern technologies play a key role in ensuring this.

Methodology

The methodological basis for my study was provided by a combination of several sources and research methods. My research was based on a combination of direct observation and qualitative methods. The literature review provides the theoretical framework, my personal experiences at festivals, recorded interviews and questionnaires provide the practical perspective, while legal documents present the formal regulatory environment. Through this complex methodological approach, my study provides an opportunity to present the application and possibilities of modern technologies that help to ensure and guarantee the safety of festival tourism.

The first phase of my work consisted of a review of the literature, in which I processed several domestic scientific dissertations, daily newspapers and internet sources. By examining these sources together, I analysed the development of tourism and, within that, festival tourism at the domestic and international levels, highlighting the safety of events and the actors involved in ensuring safety. In my analysis, I examined the role of private security, which plays a prominent role in the safety of festival tourism, and the possibilities for applying the modern technologies they use.

An important part of my research was to familiarise myself with the legal environment, emphasising that I only touched on the relevant domestic regulations in my thesis and focused primarily on presenting the technical possibilities. I reviewed the relevant domestic regulations, such as Government Decree 23/2011 (III. 8.), which defines the security requirements for music and dance events. With regard to the use of drones, I examined Act XCVII of 1995 on air transport. With regard to surveillance systems and biometric identification, I examined Act CXII of 2011 on the right to self-determination in information and freedom of information. In the field of radio communication equipment use, I examined Act LXIX of 2024 on Hungary's cyber security, Act XXIII of 2023 on cyber security certification and cyber security supervision, and NMHH Decree 17/2020 (XII. 17.), which lays down the measures necessary to ensure the interoperability of devices capable of receiving digital media services.

Exploring the legal framework provides insight into the conditions for applying modern technologies that contribute to the safety of festival tourism.

In the methodology of my study, I also placed emphasis on the collection and processing of empirical data. As part of my research, I interviewed Árpád Zimányi, the organiser of the OZORA festival, and Adrienn Riba, an “experienced” festival-goer. The interviews played a particularly important role in presenting the measures taken by the organisers to increase festival safety through the use of modern technologies, while the interview with the festival-goer presents the perspective of people who want to enjoy themselves without any worries, their thoughts and expectations regarding the new types of tools and methods used at festivals. Before both interviews, I prepared a semi-structured interview outline based on key topics and main question blocks, but during the interviews I adapted flexibly to the interviewees, allowing them to digress freely on the topic, giving space for depth to reveal attitudes, motivations and experiences.

In terms of methodology, it is important to note that I was in constant consultation with Árpád Zimányi, the organiser of the OZORA festival, and that I conducted interviews on other topics before and after the festival in 2025, but we touched on the use of modern technologies on both occasions (personal communication with Árpád Zimányi, 2025).

On several occasions, I personally collected data and made visual observations at the festivals, during which I was able to see the application of modern techniques in practice. As a police officer, I gained insight into the security activities of the OZORA Festival,² the Sziget Festival,³ the Valley of Arts Festival⁴ and the EFOTT⁵ festivals, among others.

The use of modern technologies in festival tourism safety

When examining the complex system of tourism safety, and within that, festival tourism safety, it is essential to explore the tasks related to the safety of various events. It is a fundamental human right to have one's right to safety and protection upheld (NÉMETH 2020).

Festival and event security is the set of measures and activities that are applied to ensure the smooth running of a given event and the safety of the lives and property of the participants. In other words, the purpose of event security is to ensure the smooth running of the event, to screen out and keep away unauthorised persons, to protect the participants and their property, the event area and its surroundings, and to prevent disorder.

When providing security for events, it is essential and necessary for the organisers, private security services (personal and property protection, health care, fire protection, etc.) and the authorities and police to cooperate (JUHÁSZ 2008).

Ensuring the safety of music festivals, similar to ensuring public safety, is a complex task and a product of collective cooperation. Private security companies play a significant role in this task. They complement the work of the police, organisers and civil guards in

² See: <https://2025.ozorafestival.eu/>

³ See: <https://szigetfestival.com/hu/>

⁴ See: www.muveszetekvolgye.hu/?srsltid=AfmBOoqDjJRbd21ueJx7jLkKpQx0m_f_D1AEcZXYDR8menc7StC3L2jJ

⁵ See: <https://tickets.efott.hu/events/efott-2026>

a complementary model (CHRISTIAN 2022). The basics and framework for providing security at music and dance events are regulated by Government Decree 23/2011 (III. 8.).

Private security is a service provided by a licensed company (or natural person) operating on a market basis in return for remuneration, which protects the personal safety and property of the client and facilitates the fuller exercise of their rights (CHRISTIAN 2022). In Hungary, following the change of regime and the opening of the market, private security providers have become increasingly important, and the number of private security companies and personal and property security licences issued has also increased significantly (CHRISTIAN–LIPPAI 2021).

No matter how well prepared a private security provider may be, the narrowest bottleneck in its effectiveness is the weakest link in the chain, the impact of the part(s) on the whole, so the stability of the activity may also depend on the strength of the weakest element. Based on this, we must ensure that all actors involved in the creation of security as a product consider it their own and, in the process, take on their respective roles as security professionals.

A professional private security service provider, by strengthening individual and collective security awareness, almost imperceptibly involves and makes all persons affected by its activities interested in the creation of security in the common interest and in minimising the possibility of preventing offences in the manner and to the extent relevant to them (JASENSZKY et al. 2021).

The role of the police in ensuring the safety of festivals is prevention, and the police authority's role in responding, monitoring events and preparing for accountability is more prominent, while the organisers and private security professionals guarantee the safety of the festival through live personnel and property protection activities and the use of modern security technology (CHRISTIAN 2022). The aim of my study is to present the modern tools and methods that help private security professionals in their work to guarantee the safety of festival tourism.

Camera systems, facial recognition and number plate recognition technologies, and biometric identification in crowd management – especially in festival security

Ensuring the safe running of large-scale events, especially music festivals, is becoming an increasingly complex task for organisers and law enforcement agencies. With the rise of digital technologies, advanced camera systems, facial recognition and number plate recognition software, and biometric identification are playing an increasingly important role alongside traditional security measures.⁶

⁶ Act CXII of 2011 on the right to self-determination in information and freedom of information.

Biometric data: personal data relating to the physical, physiological or behavioural characteristics of a natural person, obtained by specific technical means, which enable or confirm the unique identification of that natural person, such as facial images or dactyloscopic data.

In Hungary, these tools are gradually being integrated into event management practices and are noticeably improving prevention and response capabilities.

Closed-circuit television (CCTV) systems have long been used in public spaces and event venues. Modern camera systems no longer just record events, but are also capable of real-time analysis – for example, detecting suspicious movements, rapidly growing groups of people or aggressive behaviour patterns. These systems transmit images in real time to a central security unit, where qualified operators or artificial intelligence-based systems analyse the data. The use of facial recognition technology is becoming increasingly widespread for access control and screening wanted persons. Artificial intelligence-based algorithms are capable of quickly comparing recorded facial images with databases provided by the authorities (TÓTH 2019; Magyar Hírlap 2024).

Regulating vehicle traffic is also crucial in the context of festivals. Automatic number plate recognition (ANPR) camera systems make it possible to screen out unauthorised vehicles with or without entry permits and to monitor compliance with parking regulations. The technology supports automatic entry and exit, especially if the organisers register the participants' vehicles in advance.

Biometric identification, such as fingerprint or iris scanners, is mainly used for internal security personnel identification at festivals and sporting events, where it provides unambiguous personal identification.

In summary, the integration of advanced camera systems, facial recognition, number plate recognition and biometric identification is becoming an increasingly integral part of modern crowd management and festival security systems. In Hungary, the use of these solutions is proving its effectiveness in more and more cases, while at the same time necessitating the continuous fine-tuning of ethical and legal frameworks. Although the use of these technologies raises ethical and data protection issues, their targeted, proportionate and time-limited use is legally possible in the interests of protecting public safety.

In an interview with Árpád Zimányi, he stated that the OZORA festival has a camera system consisting of at least 50 cameras divided into two closed networks, covering an area of approximately 70 hectares, which can be monitored on site and in the camera room. The system also includes number plate recognition cameras at key junctions, which help to identify where visitors are located within the festival grounds, thus assisting medical staff or the police in emergencies. The number plate recognition system is supported by an artificial intelligence analysis programme (personal communication with Árpád Zimányi, 2025).

A facial recognition system is currently being designed and tested, which uses biometric data to identify ticket purchasers based on uploaded images. The implementation of this system will greatly facilitate access control in the future, as well as the identification and location of registered persons present at the festival site in the event of a disappearance, accident or police action.

Zimányi also said that they place great emphasis on developing and ensuring safety regulations during the registration process and ticket purchase, which is why their website has been designed to clearly display the relevant regulations and provide appropriate guidance for everyone.

On the festival website, ticket buyers are required to provide their name (as it appears on their passport), nationality, date of birth, gender, the country that issued their identity

document (passport, ID card, driving licence) and a recent portrait photograph. The portrait must not be a copy of the identity document, but a recent photograph (with a recognisable face, without sunglasses or a hat, as required for identity documents), which the buyer uploads or can take when purchasing the ticket via the ticket application. When ordering from a computer, the organiser requests that the photo be uploaded in advance.

The website also provides brief information on data processing and data protection for the buyer, and states that only personalised tickets will be accepted at the gate. This means that in order for the buyer to receive their wristband, the name assigned to the ticket must match the name on the visitor's identity card/passport.

For security reasons, additional registration categories have been created based on previous negative experiences.

Starting in 2025, entry to the festival area by car will be subject to registration. The aim is to improve traffic flow at the festival, enhance security and ensure a smoother entry process. This system will help to manage and distribute arrivals more efficiently. The organiser emphasises that registration will help locate car owners in the event of a fire or accident, facilitate access to travel information and improve coordination with car rental companies. To improve the efficiency of entry, the size of the arrival car park has been doubled and a new entrance has been created.

Zimányi emphasised that the festival is free for children under the age of 14. Children under the age of 14 can only attend the festival with their parents or legal guardians, so it is extremely important that their parents take care of their registration.

Those under the age of 18 may only attend the festival with an adult companion, and children may only enter the festival if their guardian is with them in person at the time of entry.

Zimányi also reported that visitors are advised not to bring pets to the festival, but if this is not possible, registration is required to ensure smooth entry. They draw attention to the fact that those arriving with pets should always make sure that the animal feels safe, has a comfortable place to rest, and has sufficient food and water available every day. Furthermore, dogs must be kept on a leash at all times outside the campsite and must wear a name tag with a telephone number so that the owner can be contacted if necessary. Pets should not be left locked up in places where they could overheat, and visitors should not bring animals that are unfriendly, fearful, sick or in heat under any circumstances.

Drones in crowd control

Technological advances in the 21st century have created new opportunities in the field of crowd control and public safety. Drones, also known as unmanned aerial vehicles (UAVs), have played a particularly significant role in ensuring the safe running of large public events, demonstrations, sporting events and festivals.

The use of drones allows for quick and efficient surveillance of large areas. By analysing the visual information transmitted by drones, decision-makers can respond more quickly and effectively to emerging situations (CHRISTIÁN 2018). Drones are also ideal for supporting traffic management. Transport authorities and event organisers

are already testing drones to quickly detect traffic jams, accidents and road congestion, which often accompany large public events. The data collected by remote sensing helps to optimise traffic and quickly identify alternative routes (TERPECZ–SCHUSTER 2024).

However, the use of drones also raises ethical and legal issues. Data protection, respect for privacy rights and compliance with flight safety rules are key factors that must be regulated and monitored. The Hungarian legal system is constantly adapting the conditions for drone use in line with European Union regulations, with particular attention to their use at public events (CSÁK 2019). The basic concepts and rules relating to their use are contained in Act XCVII of 1995 on Air Transport. The aim of both Hungarian and EU regulations is to promote the safe use of drones by establishing flight rules, training requirements, registration obligations and other rules that virtually all drone users must be familiar with and comply with in full.

In summary, drones have become an effective tool for crowd control in Hungary as well. With the development of technology and the fine-tuning of legal regulations, they will be even more widely used in the future in the service of public safety. In an interview conducted in the summer of 2025, Árpád Zimányi said that the OZORA festival team only used drones for promotional purposes (personal communication with Árpád Zimányi, 15 June 2025). He emphasised that he was in constant consultation with the private security company responsible for maintaining order and property security at the festival site. In an interview with Árpád Zimányi in the autumn of 2025 on a different topic, he said that a drone equipped with night vision had been purchased for the security team and had already been used very effectively during the festival (personal communication with Árpád Zimányi, 10 October 2025).

The use of mobile applications, RFID⁷ and NFC⁸ technologies in crowd management – mainly at large music festivals

Thanks to advances in digital technology, crowd management practices at large events, especially music festivals, have undergone fundamental changes. The integration of mobile applications, RFID (Radio Frequency Identification) and NFC (Near Field

⁷ RFID (Radio Frequency IDentification) is a technology used for automatic identification and data communication, which essentially involves the storage and transmission of data using RFID tags and devices. An RFID tag is a small object that can be attached to or embedded in the object to be identified. The object can be an item, such as a commodity or component, or a living being, including a human being. The essence of RFID technology is the communication between a radio frequency transceiver unit and RFID tags placed on the objects being monitored. Communication takes place automatically, without human intervention. The technology can be used in many areas, such as inventory management and automatic shipment tracking, but the most common and well-known application is security tags that “beep” when they come close to a reader gate. See: www.cimkecentrum.hu/tudastar/mi-az-rfid

⁸ NFC (Near Field Communication) is a short-range, low-power, high-frequency (13.56 MHz) wireless radio communication technology (based on RFID) that enables secure and fast data exchange between electronic devices, typically within a distance of 4–10 cm. Its main characteristic is that, unlike Bluetooth, it does not require manual device pairing and is capable of communicating both between two active devices (e.g. smartphones) and between an active and a passive, unpowered device (NFC tag/microchip). Its primary areas of application include contactless mobile payments (e.g. Apple Pay, Google Pay), digital identification, and rapid data transfer (OKUNBOR et al. 2018).

Communication) technologies has significantly contributed to improving the visitor experience, enhancing security and managing logistics processes more efficiently. In Hungary, these technologies have been playing an important role in crowd management for years at events such as the Sziget Festival, Balaton Sound and VOLT Festival.

RFID (Radio-Frequency Identification) and NFC (Near Field Communication) are two closely related wireless communication technologies used to identify objects, people and authorisations and to transfer data.

RFID technology has become indispensable, particularly in the areas of access control and cashless payment. RFID chips integrated into wristbands allow visitors to enter the event area quickly and without queuing, and to purchase products and services. This not only increases logistical efficiency, but also significantly reduces the possibility of theft and fraud.

NFC technology, as a short-range communication solution, is increasingly being used in mobile payments and personal identification. By utilising the NFC functions of smartphones, organisers can respond quickly to security situations, such as suspicious movements or overcrowded areas.

In addition, NFC-based solutions also facilitate rapid evacuation by enabling the tracking of individuals within the event area.

Mobile applications allow participants to receive real-time information about programmes, venues, security alerts and crowd movements. These applications contribute to more independent and informed movement of visitors, which reduces congestion and pressure on human resources.

For Hungarian festival organisers, the use of these technologies not only serves to maintain competitiveness, but also to enhance safety. The data collected at events is analysed by the organisers afterwards and used to refine future crowd management strategies.

Overall, it can be said that the integrated use of mobile applications, RFID and NFC technologies has become indispensable for the modern and safe running of large-scale events. The Hungarian practice is a good example of how smart technologies can combine the dimensions of organisation, security and visitor experience.

Árpád Zimányi said that the festival does not use either RFID or NFC technology for guests, and unlike in previous years, it does not even operate a mobile application. He explained that performers and service staff have RFID-enabled wristbands that grant access to different areas and entitle the wearer to various services, such as meals, coffee, etc.

In his opinion, instead of a mobile application, their website, which works well in offline mode, provides assistance that visitors use effectively and prefer to use. Árpád Zimányi emphasised that they already use the increasingly popular and widespread QR codes, which can be downloaded to phones, in many areas, as they can also contain a great deal of data, thus helping with security and logistics. He sees great potential in the use of QR codes and biometric identification, arguing that they are inexpensive and can be easily integrated into existing systems (personal communication with Árpád Zimányi, 2025).

Radio communication

Digital radio communication systems have become essential tools for large-scale, real-time, reliable voice-based communication. The legal framework for these systems in Hungary is provided by Act LXIX of 2024 on Cybersecurity in Hungary, Act XXIII of 2023 on Cybersecurity Certification and Cybersecurity Supervision, and NMHH Decree 17/2020 (XII. 17.) on measures necessary to ensure the interoperability of digital media devices.

Fast and reliable communication is essential for festival security personnel. Hytera's DMR (Digital Mobile Radio) system enables encrypted, interference-free communication, which is particularly important for coordination in large crowds (Hytera s. a.). DMR technology, which operates according to the ETSI standard, is scalable and can be integrated with other security systems (ETSI 2018).

Árpád Zimányi stated that they use Hytera's DMR system, as rapid response, secure data flow and uninterrupted group communication are essential in organisation and security (personal communication with Árpád Zimányi, 2025). Their system is based on two repeater stations, five channels and 220 radio devices (150 organisers and 70 security personnel), ideally serving the security network needs of a large event. The heart of the system is the two Hytera repeaters, which are connected to each other via an IP network, ensuring extended coverage and stable connections even over distances of several kilometres.

DMR technology allows a single physical channel to function as two separate communication slots (TDMA), so the 5-channel system actually provides ten separate voice channels simultaneously. This is particularly effective when multiple departments (e.g. security, technical staff, event organisers) operate on separate channels but can quickly switch to shared communication when necessary (ETSI 2018).

With the appropriate grouping of 220 radio devices, the system is highly scalable and easy to manage. Hytera devices support GPS-based positioning, text messaging and an emergency call function, which is particularly important for security applications.

Control software that can be connected to the system (e.g. Hytera SmartDispatch) allows for live traffic monitoring, call log management, and even remote programming (Hytera s. a.). The digital radio communication system developed with Hytera technology offers a modern, secure and reliable solution for a large number of users.

The use of modern technologies for festival safety from a festival-goer's perspective

As part of my research on festival tourism safety, I interviewed Adrienn Riba, who has been regularly attending festivals in Hungary for almost ten years, but also has international experience. She usually attends festivals as a guest, but in many cases also as a fire juggler.

When asked what she thinks about the camera systems used at festivals, Adrienn Riba said,

“on the one hand, it’s very good, but on the other hand, not necessarily. I can’t imagine every square metre of the festival being covered by cameras, that would kill the festival. It’s good for shops, stores and other hubs, because if someone steals something, it can be tracked. It’s important to choose the right measure and location, but don’t put cameras on the stages, because I think that violates personal rights.”

She explained that she considers drone surveillance to be very good, but primarily from a security and property protection perspective. Adrienn has experienced that many unauthorised intruders with the intention of stealing have appeared at the OZORA Festival in the past, but in 2025, the organiser was able to curb this by monitoring agricultural areas using drones. She considers chip or other card applications to be useful for monitoring the movement of workers and performers in different zones and for dividing areas, but they have no role among festival visitors. Adrienn prioritises personal rights over security in this area.

Closing thoughts

Modern technologies contribute significantly to maintaining and enhancing security at large music festivals, but special attention must be paid to ethical and data protection issues when applying these technologies. Future developments must be guided by transparency, ethical application and respect for the rights of participants. Internet sources and international examples also clearly show the direction of development. According to a statement by Hanwha Vision, a South Korean security technology company, artificial intelligence and predictive analytics play a key role in event security, especially in predicting crowd movements (Hanwha Vision 2024). In addition, Reuters reported that India had increased security at the Maha Kumbh religious festival with drones and facial recognition systems (SHARMA–MEHTA 2025). Some authors have even stated that RFID, NFC technologies and drone shows are among the coolest festival technologies, not only serving security purposes but also being spectacular elements of modern event organisation (Socialnomics 2023).

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